0.1 Introduction

Climate risk assessment is becoming central in contemporary activities related in any way to the environment and whose assets could be affected by climate change. In particular, climate change risk assessment is a topic more and more organizations are considering in their decisions.

A climate change risk assessment for a given system is the analysis of the impacts of and the responses to climate change regarding that system. Various guidelines are available for these kind of risk assessments (cfr. [?, ?, ?]) and authors of assessments (e.g. consulting firms) follow a common procedure. This procedure can be summarised in few steps:

1. Collect requirements, documentation and information in general from clients and users about the system which is the subject of the assessment.

2. Collect from the client data and information about climate, environment and exposed samples concerning the assessed system.

3. Determine hazards potentially affecting the exposed samples of the system and their exposure and vulnerability.

4. For each determinant, identify indicators suitable to describe the system.

5. Quantify indicators using collected data.

6. Unify previous information and climate projections to obtain the final risk, also projected into the future using specific climate change scenarios.

7. Propose mitigation and adaptation measures and responses based on the outcome of the risk assessment.

In general, slight variations of this procedure is adopted by authors and guidelines do not specify precisely the practical details of the assessment. In particular, there is no objective method to choose the climate indicators used in the assessment, but they are selected according to their effectiveness in scientific literature and in previous assessments, combined with the personal experience of the authors. The choice of the indicators is far from objective.

0.1.1 Structure of the document

The landview of terms and definitions used in climate change risk assessment is varied and this may cause confusion. For the sake of clarity, definitions are provided, along with the sources they are taken from. If no specification of the source is present, the definition is assumed to be taken from [?] or [?]. Terms which are present in both sources have equivalent definitions.

0.2 Data

Climate data show great complexity in structure and availability. For these and other properties they can be regarded as big data.[**?**] Each Essential Climate Variable (ECV) can be represented as a multidimensional object and in this work a generic ECV E is represented mathematically as a scalar function

$$E : D_{\mathrm{time}} \times D_{\mathrm{lat}} \times D_{\mathrm{lon}} \to \mathbb{R} \tag{1}$$

where D_{time}, D_{lat} and D_{lon} are domains of time, latitude and longitude coordinates, respectively.[1]

[1] In Machine Learning-related fields these objects are called tensors. Since they may not satisfy the mathematical definition of a tensor, in particular the numerical sets over which they are defined may not be vector spaces, in this work no reference to multilinear algebra is made.

Definitions

hazard Here is used the IPCC's definition: "The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources", from [**?**, 2233]. Note that this concept focues on the negative impacts of the physical drivers, the term *Climatic impact-driver* is used for conditions with more general impacts (cfr. [**?**, 2224], [**?**, 10] and [**?**, 1871]). In this document the term Driver is used.. *see* driver

Acronyms

ECV Essential Climate Variable. 2